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Indian Standard

METHODS FOR DETERMINATION OF COLOUR FASTNESS OF TEXTILE MATERIALS TO WEATHERING BY XENON ARC LAMP

(*First Revision*)

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METHODS FOR DETERMINATION OF COLOUR FASTNESS OF TEXTILE MATERIALS TO WEATHERING BY XENON ARC LAMP

(First Revision)

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Indian Standard

METHODS FOR DETERMINATION OF COLOUR FASTNESS OF TEXTILE MATERIALS TO WEATHERING BY XENON ARC LAMP

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 15 October 1985, after the draft finalized by the Chemical Methods of Test Sectional Committee had been approved by the Textile Division Council.

0.2 This standard was first published in 1971 and has been revised to include changes carried out in other similar colour fastness standards regarding sampling, specimen size, apparatus and to align it with ISO 105-B04-1981 'Textiles — Test for colour fastness to weathering — Xenon arc' issued by the International Organization for Standardization.

0.3 Colour fastness of textile materials to weathering (out-door exposure) is of considerable strategic importance to consumers especially in case of defence textile stores like camouflage material, tents and tarpaulins, which are especially dyed and printed so as to mix with the surrounding colours of nature. As the out-door exposure method takes long time to complete a test, a quick method of determining colour fastness to weathering is by use of artificial light (xenon lamp) in simulated weather conditions. However, there is likelihood that the results obtained by this method may differ from the results obtained by out-door exposure. In case of dispute the latter method should be followed.

0.4 Two methods for mounting and testing of specimens for colour fastness to weathering by xenon arc lamp have been prescribed in this standard. Method 1 is considered preferable and should be used in cases of dispute but it requires one set of standard patterns for each test specimen. Method 2 enables a number of test specimens of differing light fastness ratings to be rated against a single set of standard patterns. This method is used when a large number of test specimens have to be tested concurrently.

1. SCOPE

1.1 This standard prescribes methods for determination of colour fastness of textile materials of all kinds and in all forms except loose fibres to the action of weathering as simulated by exposure in a cabinet equipped with Xenon arc lamp.

2. PRINCIPLE

2.1 Specimens of textile are exposed under specified conditions to light from a Xenon arc lamp and to water spray. At the same time and in the same cabinet, eight standard patterns of blue wool cloth are exposed to light but are protected from water spray by a sheet of window glass. The fastness is assessed by comparing the change in colour of the textile with that of the standard patterns.

3. SAMPLING

3.1 Lot — The quantity of same kind of yarn or fabric dyed or printed under essentially similar conditions shall constitute a lot.

3.2 Samples shall be drawn from the lot so as to be representative of the lot. Samples drawn as prescribed in material specification for the coloured textile materials or as agreed to between the buyer at the seller shall be held to be representative of the lot.

4. PREPARATION OF TEST SPECIMENS AND STANDARD PATTERNS

4.1 Test Specimens — If the material to be tested is a fabric, draw two test specimens from each lot, each of area not less than 1 cm × 4·5 cm mounted on holders or other equipment which will fit the weathering test equipment.

4.1.1 If the material to be tested is yarn, it should be knitted or woven into a fabric and then treated as in **4.1.** If facilities do not exist for knitting or weaving the yarn into fabric, the yarn may be wound over an inert material covered with a piece of scoured, undyed cloth made of hydrophobic fibre such as polyester or acrylic. Draw two such specimens from each lot.

NOTE — Loose fibres are not suitable for weathering tests.

4.2 Standard Patterns — Mount strips of light fastness standard patterns (*see* **5**) on a cardboard and cover the middle one third (*see* Fig. 1 and 2) with an opaque cardboard.

NOTE 1 — To facilitate handling, the test specimens and strips of standard patterns of similar size may be mounted on a card in some such arrangement as indicated in Fig. 1 or Fig. 2. Each exposed and unexposed area shall not be less than 1 cm × 1 cm.

NOTE 2 — The test specimens and the standard patterns should be of equal size and shape in order to avoid errors in assessment due to over rating the visual contrast between exposed and unexposed parts on the larger patterns as against the narrower standard patterns.

NOTE 3 — When testing carpets, the standard patterns shall be arranged in such a way that they are at the same distance from the light source as the surface of the carpet specimens. This can be achieved by underlayed cardboard.

5. STANDARD PATTERNS

5.1 Standard patterns of blue wool cloth with light fastness ranging from rating No. 1 (very low light fastness) to rating No. 8 (very high light fastness) and dyed with the dyes as prescribed below, shall be used for this test:

Fastness Rating No.	*Dye* [*Colour Index* (*CI*), *Designation* (*see Note 1*)]
1	CI Acid Blue 104
2	CI Acid Blue 109
3	CI Acid Blue 83
4	CI Acid Blue 121
5	CI Acid Blue 47
6	CI Acid Blue 23
7	CI Solubilized Vat Blue 5 (*see* Note 2)
8	CI Solubilized Vat Blue 8 (*see* Note 2)

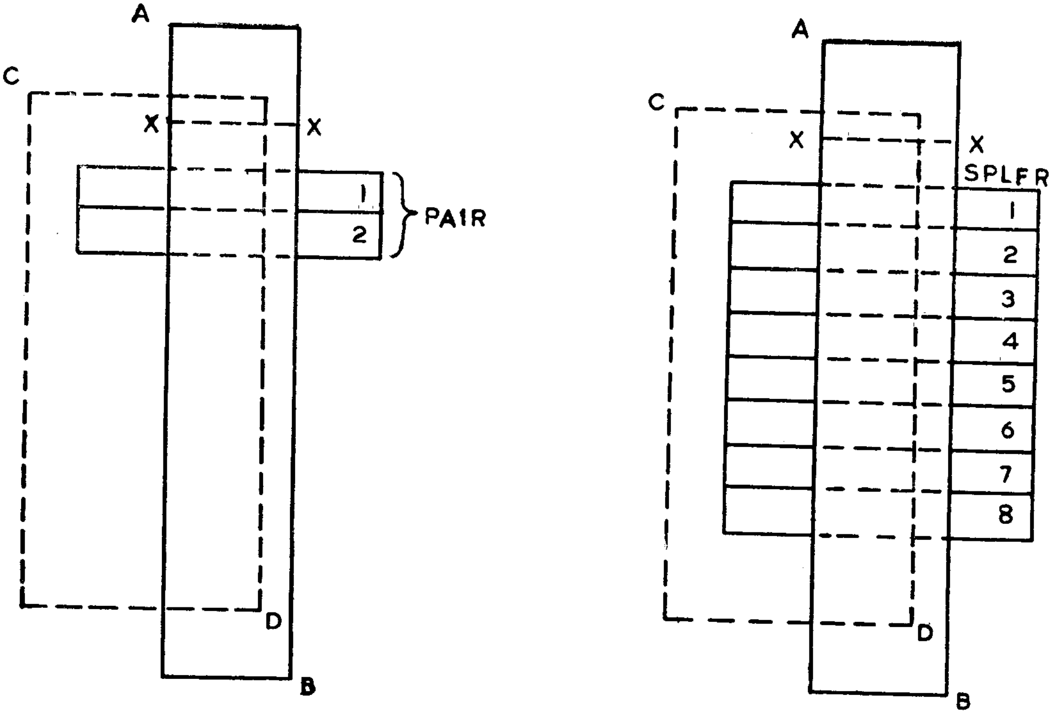
NOTE 1 — The Colour Index (Third Edition) published by the Society of Dyers and Colourists, P.O. Box 244, Parkins House, 83 Gratton Road, Bradford BD1 2 JB, West Yorks, UK.

NOTE 2 — The patterns dyed with these dyes should be decatized after dyeing.

NOTE 3 — Sets of standard patterns of light fastness rating No. 1 to 8 may be obtained from the Indian Standards Institution or the British Standards Institution. They are specially dyed to match the master set of standard patterns in colour and in fading behaviour. It has been found that when repeated dyeings for the dyed standard patterns are made, the amount of dye required to match a previous lot is often different from that originally used. The dyeing strengths would, therefore, be misleading and they are intentionally omitted from this list.

6. APPARATUS

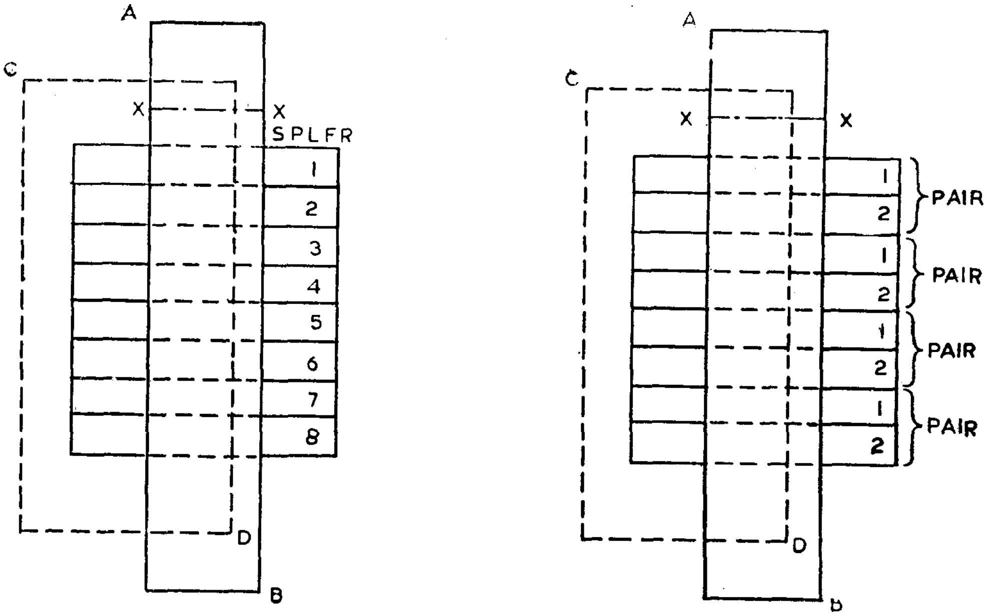
6.1 Light Source — It shall be Xenon arc lamp having correlated colour temperature between 5 500 to 6 500 K kept in well ventilated exposure chamber.



1A Exposure of Test Specimens

1B Exposure of Standard Patterns

Fig. 1 Mounting of Test Specimens and Standard Patterns for Method 1



2A Exposure of Standard Patterns

2B Exposure of Test Specimens

FIG. 2 MOUNTING OF STANDARD PATTERNS AND TEST SPECIMENS FOR METHOD 2

6.2 Light Filter — A special kind of glass possessing transparency of 90 percent between 380 to 750 nm and which is opaque between 310 to 320 nm is placed as filter between the light source and the assembly of test specimen(s) and standard patterns so that the ultraviolet spectrum is steadily reduced.

6.3 Heat Filters — These are used to minimize the infra-red radiation (which is present in appreciable amount) of the spectrum of the Xenon arc to satisfy temperature conditions. They should be cleaned regularly to avoid undersirable reduction in light intensity by dirt.

6.4 Opaque Cardboard or Thin Opaque Material — It shall be a thin sheet of aluminium or cardboard covered with aluminium foil, or in the case of pile fabrics a cover that avoids surface compression.

6.5 Geometric Grey Scale — For evaluating the change in colour (*see* IS : 768-1982*).

6.6 Black Panel Thermometer — (*see* Note *under* **7.1.2**).

7. EXPOSURE CONDITIONS

7.1 The following exposure conditions should be satisfied during tests.

7.1.1 The variation of the light intensity over the area covered by the test specimens and standard patterns shall not exceed ± 10 percent of the mean.

7.1.2 The specimens shall be exposed in a well-ventilated exposure chamber. The air temperature in the chamber shall not exceed 40°C during the drying period. The temperature shall be measured with a thermometer whose bulb is shielded from the direct radiation of the arc. The temperature of the black panel which is measured in the same position and under the same illumination as the specimen shall not exceed that of the test chamber more than 20°C at the maximum drying period.

NOTE — The black panel thermometer should consist of a metal panel at least 4·5 cm × 10 cm whose temperature is measured with a thermometer or a thermocouple with its sensitive portion located in the centre and in good contact with the panel. The side of the panel facing the light source shall be black with a reflectance of less than 5 percent throughout the spectrum reaching the specimen; the side of the panel not facing the light source shall be thermally isolated.

7.1.3 The specimens mounted in rotating holders shall be subjected to an accurately adjusted and reproducible weathering cycle of:

a) Length of spraying — 1 min (rain period)

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*Method for evaluating change in colour (*first revision*).

b) Length of drying — 29 min (drying period)

NOTE 1 — For spraying the specimens, completely ion-free water shall be used. It should be especially noted that this water must not contain any metal salts. Tubing, tanks and spray jets must be made of corrosion resistant material.

NOTE 2 — The specimens should completely enclose the holder and the side to be assessed should not be in contact with metal plates, other specimens or backing fabric.

8. PROCEDURE COMMON TO METHOD 1 AND 2

8.1 Place the test specimen(s) mounted on the holders in the frame (*see* Fig. 1) and expose them to weathering.

8.2 At the same time expose the mounted and partially covered blue wool standard patterns (*see* **4.2**) to light in the glass case of the same frame. The standard patterns shall be protected from the water spray by a shield of window glass whilst being exposed to light. The window glass used should have transparency of at least 90 percent between 380 to 750 nm and be completely opaque between 310 to 320 nm. The glass case should be well ventilated, that is, there should be an opening on the top and bottom which allows a good circulation of air.

8.3 Expose the specimens and the standard patterns simultaneously for 24 hours per day, for such times as are necessary to evaluate the weathering fastness, using either Method 1 or Method 2 for mounting the test specimens and standard patterns (*see* **8.4** and **8.5**).

NOTE 1 — Only one side of the specimen shall be exposed to weathering and light.

NOTE 2 — Whilst the specimens are drying, the air in the test chamber shall not be moistened.

NOTE 3 — The conditions of the weathering test depend on the kind of test apparatus used.

NOTE 4 — Contrary to stipulations for the outdoor exposure test, the specimens must not be washed after the weathering test.

8.4 Method 1

8.4.1 Expose the specimens and the standard patterns (*see* Fig. 1) under the conditions as given in **8.1** to **8.3** until the contrast between the exposed specimens and portion of the original fabric is equal to Grade 3 on the grey scale. Remove one of the specimens and cover the left hand one-third of the standard patterns with an additional opaque cover.

8.4.2 Continue the exposure until the contrast between the remaining specimen and a portion of the original fabric is equal to Grade 2 on the grey scale. If Standard Pattern 7 fades to a contrast equal to Grade 4 on the grey scale before the contrast between the specimen and the portion of the original fabric is equal to Grade 2 on the grey scale, the exposure may be concluded at this stage and the remaining specimen and the standard patterns removed.

8.4.3 Prepare the specimens as well as a portion of the original fabric for assessment to weathering fastness (*see* **8.5.4** and **8.5.5**) and assess as given in **8.6**.

8.5 Method 2

8.5.1 Expose the specimens and the standard patterns (*see* Fig. 2) under the conditions given in **8.1** to **8.3** until the contrast between the exposed and the unexposed portions of standard pattern 6 is equal to Grade 4 on the grey scale. At this stage, remove one specimen from each pair and cover the left hand one-third of the standard patterns with an additional opaque cover.

8.5.2 Continue the exposure until the contrast between the fully exposed and unexposed portion of Standard Pattern 7 is equal to Grade 4 on the grey scale. Remove the remaining specimens and the standard patterns.

8.5.3 Prepare the exposed specimens as well as a portion of the original fabric from each specimen for assessment to weathering fastness (*see* **8.5.4** and **8.5.5**) and assess as given in **8.6**.

8.5.4 Dry the specimens in air at a temperature not exceeding 60°C before mounting for assessment.

8.5.5 Trim and mount the tested specimens measuring at least 15 mm × 30 mm, one on each side of a portion of the original fabric which has been trimmed to the same size and shape as the specimens. The specimen exposed for shorter length of time should be mounted on the left.

8.6 Assessment of Fastness

8.6.1 *First Assessment* — Compare the magnitude of the contrast between the specimen exposed in the shorter time and original fabric in terms of the contrasts produced on the Standard Patterns exposed for the same period. The assessment is the number of Standard Pattern(s) showing the contrast closest to that of the specimen. If the specimen shows the change in colour approximately half way between the two Standard Patterns an appropriate half rating, for example, 5-6, shall be given.

NOTE 1 — The term 'change in colour' includes not only true fading; that is, destruction of dyes but also changes in hue, depth, brightness or any combination of these characteristics of colour. If the difference in colour is a change of hue or brightness, this may be indicated by adding abbreviations as follows to the numerical fastness ratings:

Bl = bluer,
R = reder,
Y = yellower,
G = greener,
D = duller, and
Br = brighter.

If the change in hue is accompained by change in depth, this may also be indicated:

W = weaker, and
Str = stronger.

NOTE 2 — Phototropic test specimens should be allowed to condition in dark at room temperature for 24 hours before evaluating the change in colour.

NOTE 3 — In case of doubt in the colourfastness rating as assessed by an observer, the assessment may be made by three observers and the overall average rating may be reported accordingly.

8.6.2 If specimens larger than the standard patterns are exposed, a mask of neutral grey colour midway between Grade 1 and Grade 2 of the grey scale (approximately Munsell N5) should be used in the assessment covering the surplus area of the specimens and leaving an area equal to that of the standard patterns open for comparative evaluation.

9. REPORT

9.1 The report shall include the following:

a) Numerical ratings of weathering fastness — Xenon lamp.

NOTE — If the two assessments (*see* **8.6.1** and **8.6.2**) are different, report only the lower one.

b) Model of the apparatus used for the test.

(*Continued from page* 2)

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